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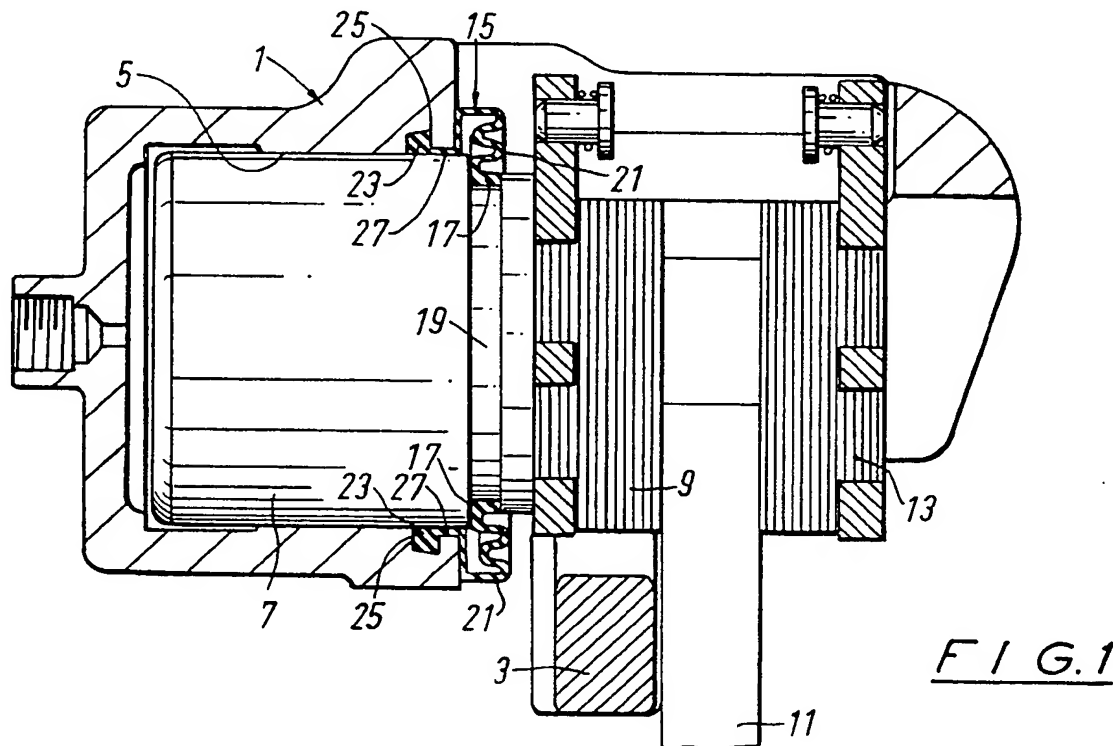
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(54) Improvements relating to seals  
used in piston and cylinder  
arrangements

(57) The present invention provides for a piston and cylinder arrangement a flexible boot (15) which engages in retaining grooves (25,19) provided on the outside of the piston (7) and on the inside wall (5) of the cylinder adjacent to the open end of the cylinder, the part (23) of the flexible boot (15) engaging in the retaining groove (25) in the inside wall (5) of the cylinder, being compressed radially of the cylinder to thus act as a pressure seal between the piston (7) and cylinder. By virtue of this dual function, the piston (7) can be shortened and the weight of the arrangement induced. Also assembly is simplified. An anti-extrusion or reinforcing ring may be moulded into the part 23 of the boot.



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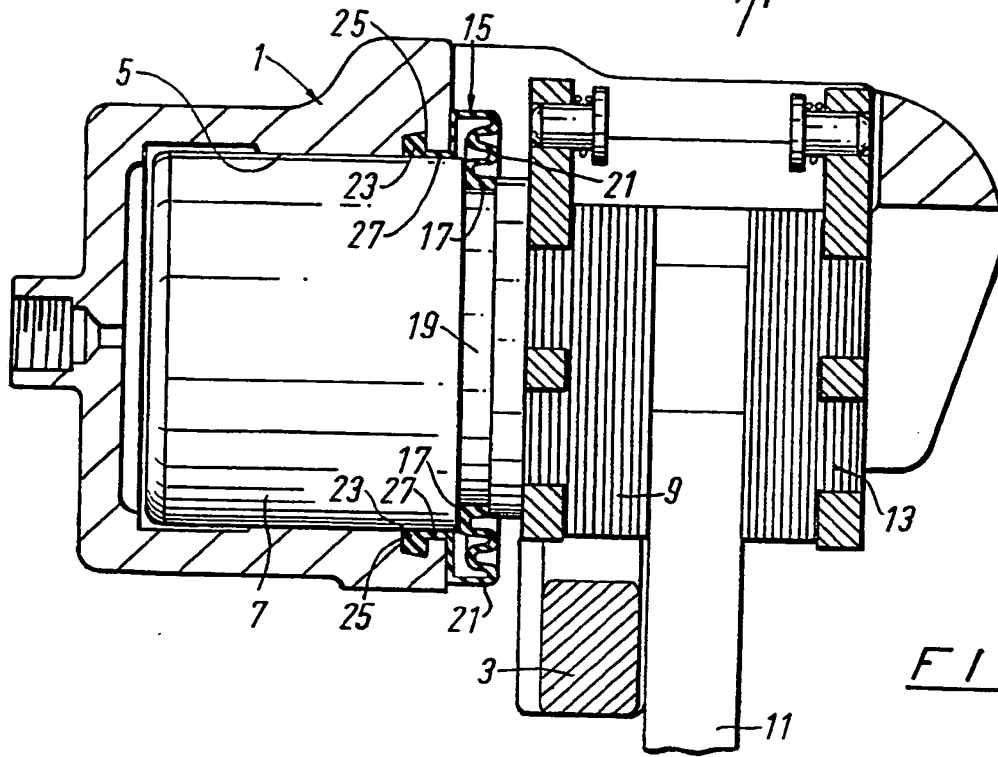


FIG. 1

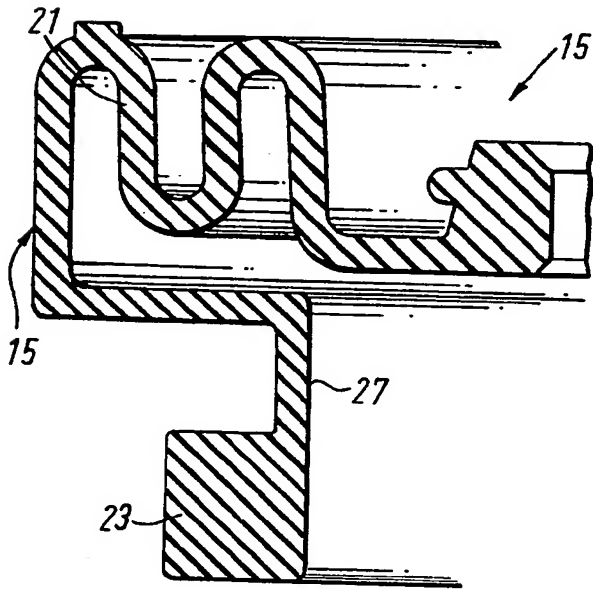


FIG. 2

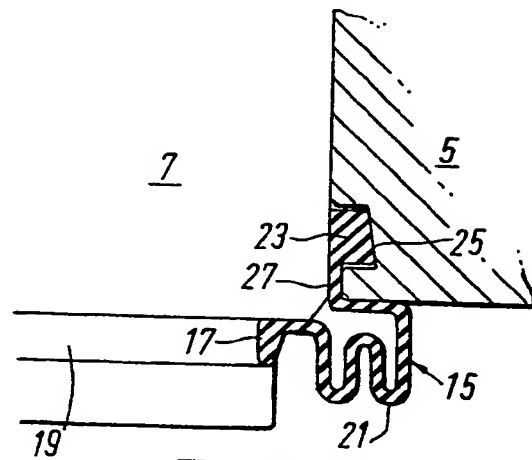


FIG. 3

## SPECIFICATION

**Improvements relating to seals used in piston and cylinder arrangements**

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The present invention relates to a piston and cylinder arrangement, and the seals provided therebetween to enable the piston and cylinder to continuously work as desired.

10 In particular the present invention relates to the piston and cylinder arrangement used in a vehicle brake as the brake actuator. Such arrangements are either hydraulically or pneumatically operable. In disc brakes it is common for the piston and cylinder of the brake actuator to be effectively sealed against the ingress of dirt by a flexible boot arranged between the piston and cylinder at the cylinder open end. Such a flexible boot is shown in British Patent Specification No. 1239885, this boot merely protecting the sliding surface between piston and cylinder by covering the gap therebetween at the open end of the cylinder. It has also been proposed, as disclosed in U.S. Patent Specification No. 3490343, to provide such a flexible boot as previously described, with a wiper lip which engages the outer sliding surface of the piston. This wiper lip provides dual protection by maintaining protection against the ingress of dirt between cylinder and piston, should the flexible boot fracture during service.

30 Both of the above prior arrangements still require the presence of a separate pressure seal. The pressure seal is either in a groove in the cylinder housing, as in British Patent Specification No. 1239885, or in the piston, as in U.S. Specification No. 3490343. This pressure seal is advantageous to the performance of all disc brakes both to prevent fluid leakage past the piston and loss of pressure, and to provide an automatic piston retraction i.e. rollback, facility, upon brake release. This latter rollback facility is due to the grip between the piston and seal, or seal and cylinder, and the resilience of the pressure seal. When the brake is released the pressure seal returns to its original configuration, dragging back the piston into the cylinder. This facility is dependent upon several factors e.g. seal material, groove form, etc.

However the provision of both the advantageous pressure seal and the flexible boot, necessitates the piston to be of a certain axial length. Also two retaining grooves can be required in the piston or cylinder, and the seals have to be separately assembled.

The aim of the present invention is to provide a piston and cylinder arrangement with the fundamentally required flexible boot and pressure seal, which construction is simpler to manufacture and assemble than prior art constructions, and additionally has some further advantages.

According to the present invention there is provided a piston and cylinder arrangement comprising a piston axially slidably located in a cylinder, the piston being slidable at least partially, out from one open end of said cylinder, a flexible boot engaging the outside of the piston and the inside wall of the cylinder adjacent to said one open end of the

cylinder, one part of said flexible boot engaging in a retaining groove in the inside wall of the cylinder, and being compressed radially of the cylinder, between the outer wall of the piston and the bottom of the retaining groove in the cylinder wall, to thus form a pressure seal between the piston and cylinder.

Thus the present invention provides a combined flexible dust boot and pressure seal, requiring a reduced number of assembly steps as compared to the assembly of prior art constructions with separate pressure seals and boots. Also, as two seals are now not secured to the piston or cylinder, the axial length of the piston can be reduced for, for example, the same braking actuation and pad wear distance as prior art constructions, with a separate pressure seal and flexible boot. Thus the cylinder length can be reduced and the caliper reduced in overall size. This means an advantageous reduction in brake weight whilst retaining the same brake performance. Also, the number of retaining grooves is reduced as compared to prior art constructions with a separate pressure seal. Thus manufacturing time and cost are thereby reduced, as is assembly time.

90 The main criterion of the present invention is that the part of the flexible boot held in the retaining groove in the inside wall of the cylinder, is radially compressed between the piston and the base of the groove, thereby forming the required pressure seal. No compression axially of the piston and cylinder is required. The seal in the present invention extends from the retaining groove in the cylinder wall, along the widened cylinder between the cylinder and piston, to the open end of the cylinder. The gap between the piston and the widened end of the cylinder is sufficient to allow the flexible boot to freely pass therethrough.

In operation, the pressure seal part of the flexible boot tends to be extended between the piston and cylinder, and to ensure that the pressure seal part is retained in the groove in the cylinder in anti-extrusion or reinforcing ring may be moulded into the pressure seal part or the part of the seal which extends between the piston and cylinder.

Further, whilst the combined flexible boot and pressure seal is preferably made of the same resilient material e.g. Ethylene Propylene Dienterpolymer, and is of integral construction, the pressure seal part and flexible boot may, if desired, be made separately and of different materials, and may be joined together by an intermediate arrangement.

The present invention will now be further described, by way of example, with reference to the accompanying drawings, in which:-

120 *Figure 1* is a cross-sectional view of a disc brake incorporating one embodiment of a piston and cylinder arrangement according to the present invention;

*Figure 2* is an enlarged cross-sectional view of part of the combined flexible boot and pressure seal used in *Figure 1*; and

*Figure 3* shows how the combined flexible boot and pressure seal of *Figures 1* and *2*, is installed in a piston and cylinder.

130 Considering *Figure 1* of the accompanying draw-

ings, a disc brake is shown in cross-section, the brake comprising a caliper 1 and torque taking member 3. The caliper 1 defines a cylinder 5 within which a piston 7 is axially slidable, piston 7 being moved hydraulically (or pneumatically) to press inboard friction pad 9 against disc 11, reactive movement of the caliper 1 pressing outboard friction pad 13 against the opposite side of disc 11.

An annular seal 15 extends between the sliding surface of the piston 7 and the inside wall of the cylinder 5, as best seen in Figures 1 and 3. The seal 15 comprises a piston portion 17 which engages in an annular groove 19 in the forward end region of the piston, a flexible portion 21, and a pressure seal portion 23. The pressure seal portion 23 engages in a retaining groove 25 provided on the inside wall of the cylinder 5 adjacent to the open end of cylinder 5, and is compressed radially of the cylinder 5, between the sliding surface of piston 7 and the base of retaining groove 25.

Between retaining groove 25 and the open end of cylinder 5 the cylinder base is widened, to allow seal portion 27 contiguous to pressure seal portion 23, to pass between the piston and cylinder. The gap between the piston and cylinder is sufficient to allow seal portion 27 to pass freely there-through.

A single annular seal 15 thus doubles both as a flexible boot preventing the ingress of dirt to the sliding surfaces of the piston and cylinder, and as a pressure seal preventing the egress of pressure fluid. By obviating the necessity for a separate pressure seal, the present invention when applied to a disc brake, enables the piston and cylinder length to be reduced as compared to prior art arrangements with the same braking performance. Thus the overall size and weight of the brake is reduced with attendant advantages. Further, as only one retaining groove is required in each of the piston and cylinder, fewer machining operations are required as compared with prior art constructions with the separate pressure seal. Thus, manufacturing costs are reduced and assembly is simplified.

To both enhance the 'rollback' facility and retain the pressure seal portion 23 in retaining groove 25, the base 29 of retaining groove 25 is preferably angled to deepen the groove towards the open end of cylinder 5. Also, an anti-extrusion or reinforcing ring can be moulded into the pressure seal portion 23 or adjacent seal portion 27 to make sure that the pressure seal portion is not forced completely out of groove 25.

Whilst the illustrated annular seal 15 i.e. combined boot and pressure seal, is moulded as a single integral member, the seal 15 could be made from two separately moulded members which are subsequently interconnected by an intermediate arrangement (not shown). This would enable different materials to be used, if desired, for the pressure seal and flexible dust boot.

The present invention thus provides a piston and cylinder assembly with a combined flexible dust boot and pressure seal, which assembly is simple to assemble, cheaper to manufacture than prior arrangements, and has certain additional advantages, especially if used in a vehicle brake.

## CLAIMS

1. A piston and cylinder arrangement comprising a piston axially slidably located in a cylinder, the piston being slidable at least partially, out from one open end of said cylinder, a flexible boot engaging the outside of the piston and the inside wall of the cylinder adjacent to said one open end of the cylinder, one part of said flexible boot engaging in a retaining groove in the inside wall of the cylinder, and being compressed radially of the cylinder, between the outer wall of the piston and the bottom of the retaining groove in the cylinder wall, to thus form a pressure seal between the piston and cylinder.
2. A piston and cylinder arrangement as claimed in claim 1, in which the cylinder diameter is enlarged between the retaining groove on the inside wall of the cylinder and the open end of the cylinder, to allow passage of the flexible boot through the gap between the cylinder and piston.
3. A piston and cylinder arrangement as claimed in claim 1 or 2, in which the boot is constructed in two separate parts, the pressure seal part being separate from the part of the boot which engages the piston, said separate parts being interconnected.
4. A piston and cylinder arrangement as claimed in claim 3, in which said separate parts of the flexible boot are made of different materials.
5. A piston and cylinder arrangement as claimed in any one of claims 1 to 4, in which a reinforcing ring is moulded into the pressure seal part of the flexible boot.
6. A piston and cylinder arrangement as claimed in claim 2, in which a reinforcing ring is moulded into the part of the flexible boot which extends through the gap between the piston and cylinder.
7. A piston and cylinder arrangement as claimed in any one of the preceding claims, in which the base of the retaining groove in the inner wall of the cylinder, for retaining the pressure seal, is tapered radially outwards with respect to the cylinder, towards the open end of the cylinder.
8. A piston and cylinder arrangement constructed and arranged substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.